

Were Martian Valleys Cut by Springs?

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Valleys eroded from emerging groundwater are thought to have a characteristic form including steep walls, flat floors, and amphitheatre-like heads. Observations of these features on Mars have led to the morphologic interpretation that groundwater, rather than surface runoff from rainfall, was the dominant water source, which has significant implications for Martian hydrology and the associated prospects for indigenous life. However, such a connection between channel form and the erosion processes induced by groundwater (i.e., groundwater sapping) has only been demonstrated for sediments with little to no cohesion. While the near-surface lithology on Mars is unknown, the valleys have likely been carved into layered sedimentary or volcanic rock. The extension of previous work on sapping in sediments to sapping in bedrock is unclear. In order to address this knowledge gap, we are currently investigating the origin of valleys on Earth

that satisfy the morphologic criteria for groundwater sapping in the Colorado Plateau, the Snake River Plain, and the big island of Hawai'i. Our preliminary field observations indicate that other processes, such as erosion by waterfall plunge pools, might be as reasonable valley forming processes as groundwater sapping. In fact, to our knowledge a conclusive case for groundwater sapping controlling the morphologic development of a bedrock valley has not been demonstrated on Earth. Thus, it does not seem justified to conclude that Martian valleys had groundwater sapping origins based solely on their morphology.